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(54) Abstract Title
Apparatus for baking a semiconductor wafer

(57) The apparatus 10 comprises a hot plate 20 and a plurality of spacers 30 for supporting the wafer over the hot plate with variable separation between the wafer and the hot plate. Each spacer has an upper end part 40 abutting the wafer and a lower end part connected to the hot plate. The spacers may be screws, each having a corresponding threaded hole formed in the hot plate. The spacers may be smooth cylinders each sliding in a smooth walled hole passing through the hot plate, the cylinders being secured in place by perpendicular screws passing though the side walls of the hot plate. The spacers may additionally be provided with externally powered driving means.

Fig. 3

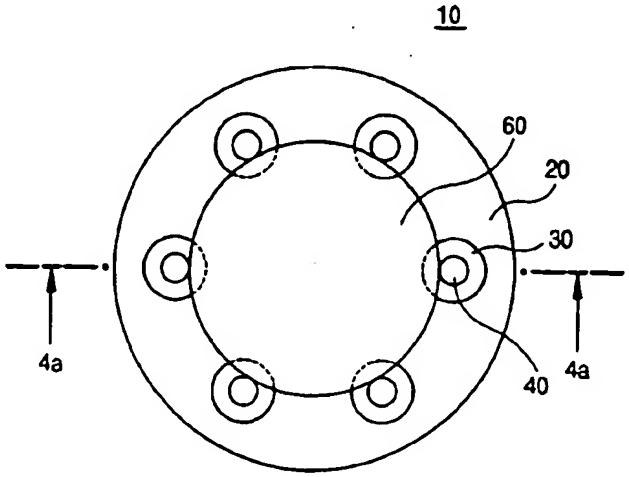

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Fig. 1

(Prior Art)

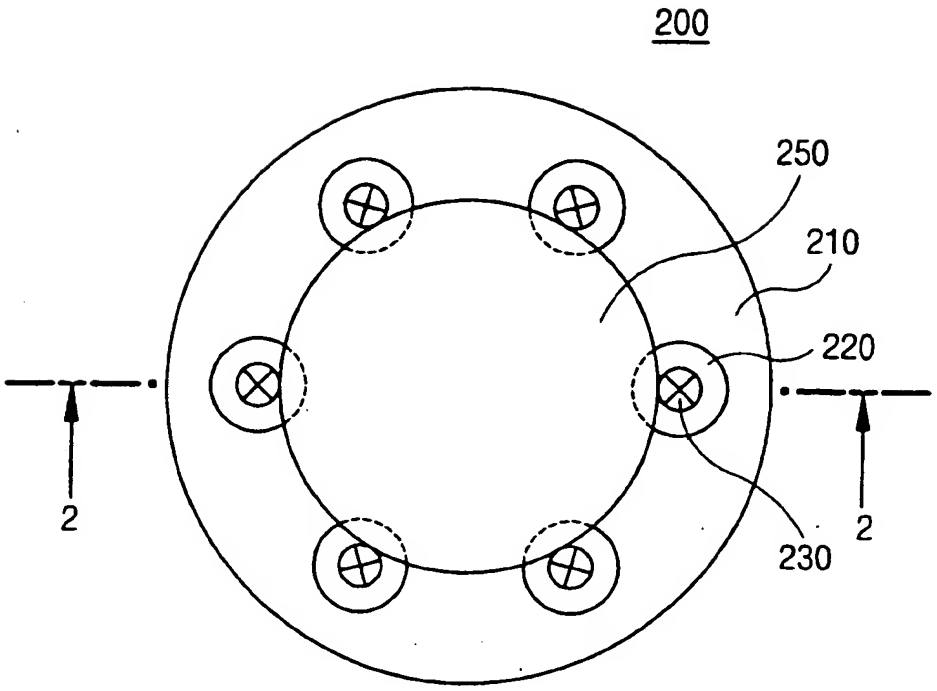


Fig. 2

(Prior Art)

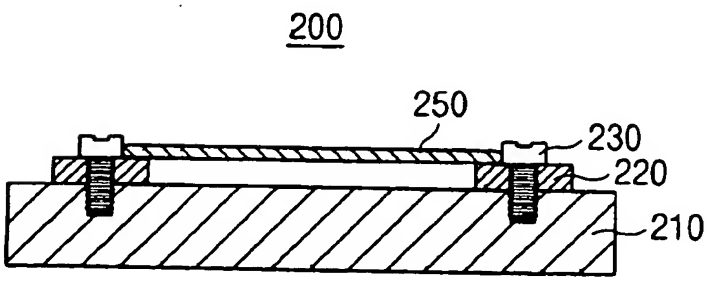


Fig. 3

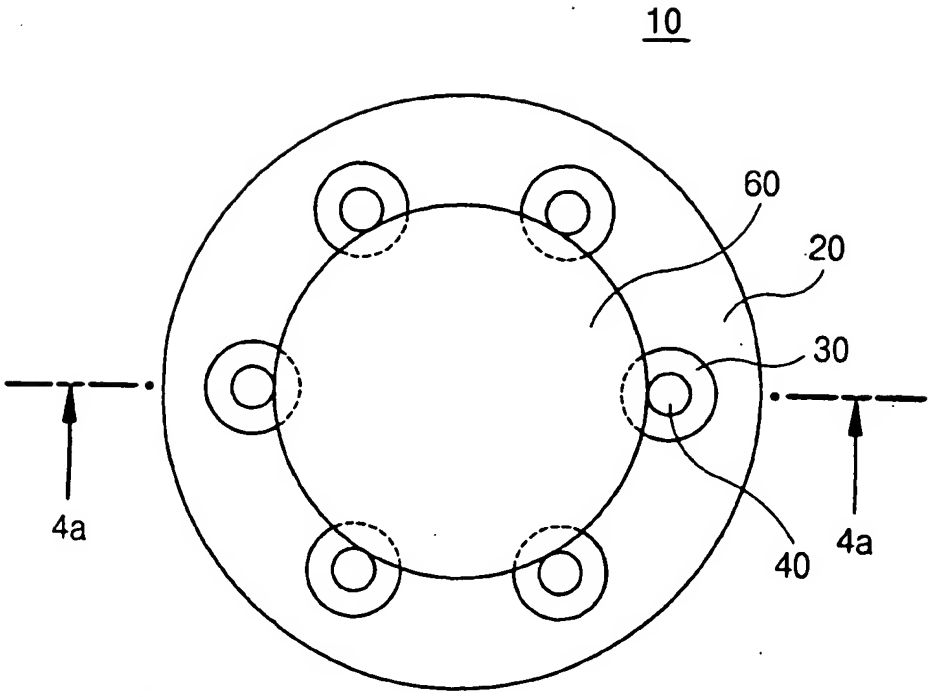


Fig. 4a

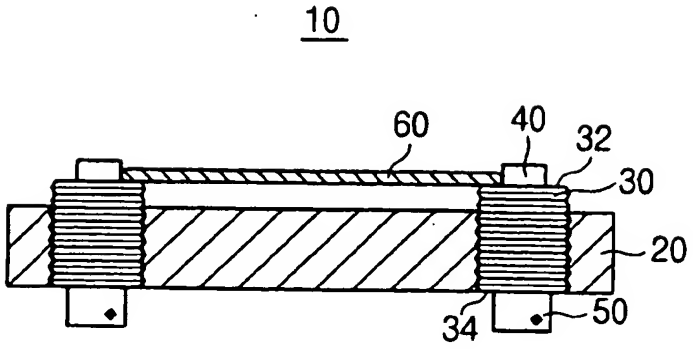


Fig. 4b

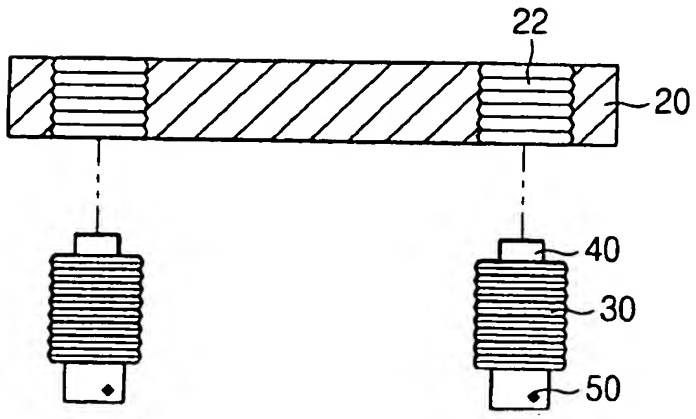


Fig. 5a

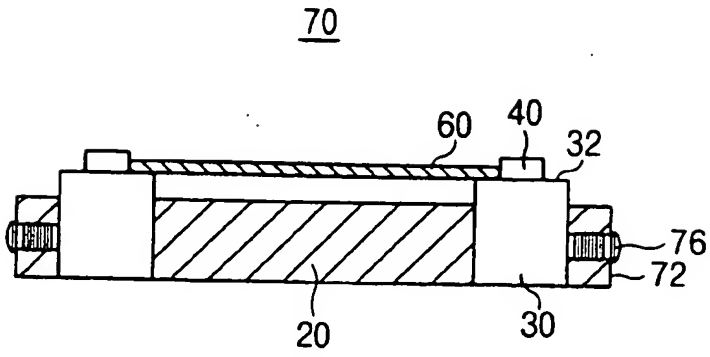


Fig. 5b

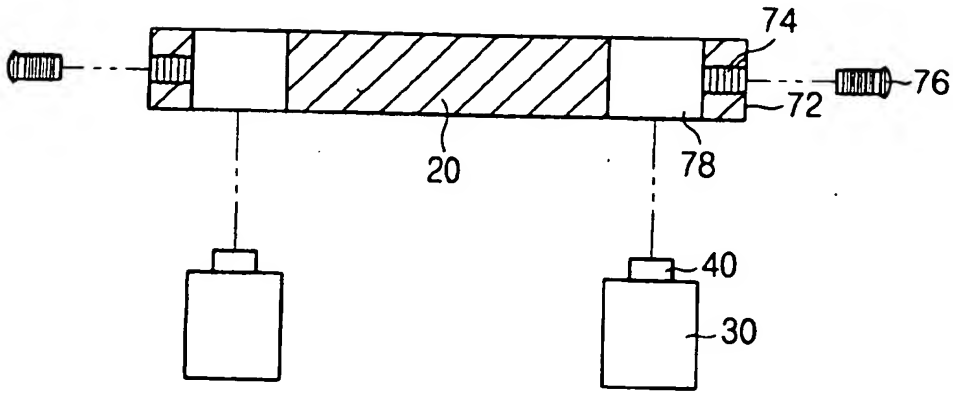
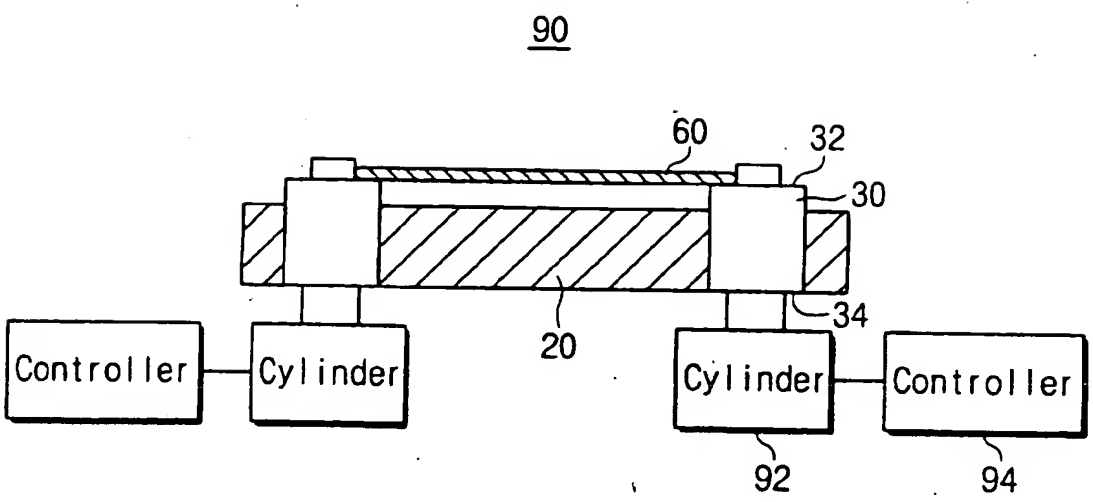


Fig. 6


90
60
32
30
34
20
Controller
Cylinder
Cylinder
Controller
92
94

APPARATUS FOR BAKING A RESIST DEPOSITED ON A SEMICONDUCTOR WAFER

Field of the Invention

The present invention concerns an apparatus for baking a photosensitive resist deposited on a semiconductor wafer to transfer a circuit pattern.

Background of the Invention

As the integration of the semiconductor device gets enhanced, it becomes more important to precisely apply photolithography. Particularly, the line width of the circuit pattern is required to have less than 0.25μm for a desirable high integration, which is not achieved by the conventional photolithography such as I-LINE. Such a fine line width is achieved by the development of the lithography such as DUV process (Deep Ultraviolet) employing KrF or ArF laser as the light source. Generally, the photo resist used in the DUV process is obtained by the chemical deposition. The chemically deposited resistor is illuminated with a DUV light source, cured by the post exposure bake (PEB) process to form a pattern. However, the chemically deposited resist contains components such as PAG (Photo Acid Generator), which are sensitive to temperature, activating H^+, so that it requires a uniform temperature in PEB process. The temperature uniformity critically affects the circuit line width formed in the wafer, so that, if the thermal stability of the baking apparatus is not secured, the tolerance of the circuit line width is not met in the light of the considerably decreased line width.

Referring to Figs. 1 and 2, the conventional hot plate assembly 200 comprises a hot plate 210, a plurality of spacers 220 and a plurality of screws 230. In baking operation, the semiconductor wafer 250 is loaded on the hot plate assembly 200. The hot plate 210 is mounted on the base of the baking apparatus (not shown), where there are also mounted a

holding device such as a chuck for holding the semiconductor wafer through the hot plate 210. The spacers 220 are mounted on the hot plate 210 with the help of the screws 230 to support the semiconductor wafer 250 over the hot plate with a certain space between them. The semiconductor wafer 250 is supported at its edge by the screws 230 fixing the spacers 220 to the hot plate 210. In operation, although it would be deemed that the wafer 250 loaded in the hot plate assembly 200 be uniformly heated throughout the whole surface, the external air flowing into the baking apparatus when opening it tends to irregularly cool the wafer surface, so that it becomes hardly possible to uniformly heat the whole surface of the wafer.

Summary of the Invention

It is an object of the present invention to provide an apparatus for baking a photosensitive resist deposited on a semiconductor wafer which may uniformly heat the resist throughout the whole surface so as to achieve the uniform circuit line width in photolithography process.

According to the present invention, an apparatus for baking a photosensitive resist deposited on a semiconductor wafer, comprises a hot plate for generating heat to bake the resist, a plurality of spacers for supporting the wafer to be spaced over the hot plate with variable distance, the spacers having the upper end part abutting with the edge of the wafer and the lower end part connected with the hot plate, and spacer movement means for raising or lowering the spacers to adjust the interval between the wafer and hot plate. Preferably, each of the spacers has a cylindrical form with peripherally spiral grooves connected with corresponding spirally grooved hole formed in the hot plate, and the spacer movement means includes a grip formed on the lower end part of each spacer. The grip is used to raise or lower the corresponding spacer by rotating.

According to one aspect of the present invention, the spacers may be connected with the hot plate to be displaced in sliding motion, and the spacer movement means includes a plurality of screws inserted into the side of the hot plate to respectively fix the spacers, so

that the spacers may be raised or lowered through the sliding motion and fixed by the screws.

According to another aspect of the present invention, the spacers are connected with the hot plate to be displaced in sliding motion, and the spacer movement means includes a plurality of externally powered drivers for respectively driving the spacers and a controller for controlling the drivers to automatically control the position of the spacers. It is also preferable that each of the spacers further includes a stopper provided at the upper end to support the periphery of the wafer.

The present invention will now described more specifically with reference to the drawings attached only by way of examples.

Brief Description of the Attached Drawings

Fig. 1 is a plane view for illustrating the hot plate of the conventional baking apparatus;

Fig. 2 is a cross sectional view taken along line 2-2 in Fig. 1;

Fig. 3 is a plane view for illustrating the hot plate of the baking apparatus according to an embodiment of the present invention;

Figs. 4A and 4B are cross sectional views taken along line 4a-4a in Fig. 3;

Figs. 5A and 5B are views similar to Figs. 4A and 4B according to another embodiment of the present invention; and

Fig. 6 is a view similar to Fig. 5B but with a mechanism for controlling the spacers according to a further embodiment of the present invention.

Detailed Description of the Preferred Embodiments

Throughout the drawings are used same reference numerals to represent the corresponding parts. Referring to Figs. 3 to 4B, the hot plate assembly 10 according to the first embodiment comprises a hot plate 20, a plurality of spacers 30, a stopper 40 mounted on each spacer and a grip 50 formed on the lower end of each spacer. The semiconductor

wafer 60 is supported on the spacers 30 to keep a certain interval from the hot plate 20 for heating the wafer. The spacers 30 are mounted on the hot plate 20 so as to support the edge of the wafer 60. The number and form of the spacers 30 may be properly determined as necessary. The spacers 30 are designed to change the height level to adjust the interval between the hot plate 20 and the wafer 60. Thus, if there occurs temperature variations in the wafer 60, for example, higher temperature in the left region of the wafer than in the right region in Fig. 3, it may be counterbalanced by lowering the spacer 30 supporting the right region. In performing photolithography process employing a negative or positive DUV photo resist, if the circuit line width of the right region of the wafer appears greater than the other regions, thus representing higher temperature than the other regions, the spacer supporting the right region is raised than the other spacers to increase the interval between the hot plate 20 and the wafer so as to reduce the amount of the heat transferred from the hot plate to the right region.

In the present embodiment, each of the spacers 30 has a cylindrical form with peripherally spiral grooves connected with corresponding spirally grooved hole 22 formed in the hot plate 20. In addition, on the lower end of each spacer is formed a grip 50, which is manually rotated by the user to raise or lower the spacer 30. The surface of the grip is knurled to prevent manual slip. The upper end of the spacer is provided with a stopper 40 to stably support the periphery of the wafer 60 and prevent displacement thereof.

In the second embodiment of the present invention as shown in Figs. 5A and 5B, the hot plate assembly 70 also includes the hot plate 20, spacers 30 and stoppers 40. The spacers 30 may be connected with the hot plate 20 through the corresponding holes 78 formed therein so as to be displaced in sliding motion. In addition, a plurality of fixing screws 76 are inserted into corresponding screw holes 74 formed in the side of the hot plate 20 to respectively fix the spacers 30, so that the spacers 30 may be raised or lowered to suitable levels through the sliding motion and fixed thereto by the screws 76.

Likewise, the hot plate assembly 90 of the third embodiment as shown in Fig. 6 includes the hot plate 20, spacers 30 and stoppers 40. The spacers 30 are connected with the

hot plate 20 as in the previous embodiment. But, in the present embodiment, the spacers 30 are displaced by an automatic controller receiving data input by the user. To this end, the hot plate assembly 90 includes a plurality of externally powered drivers or cylinders 92 for respectively driving the spacers 30 and a controller 94 for controlling the drivers 92 to automatically control the position of the spacers 30. Thus, if there occur line width variations in the circuit pattern throughout the surface of the wafer, the operator inputs data to the controller 94 to control the cylinders 92 so that the spacers 30 may be properly displaced to counterbalance the temperature variations causing the line width variations throughout the whole surface of the wafer. As described above, the invention may well be applied to an apparatus for baking a photosensitive resist deposited on a semiconductor wafer especially to achieve the circuit pattern line width of less than 0.25μm.

While the present invention has been described in specific embodiments accompanied by the attached drawings, it will be apparent to those skilled in the art that various changes and modifications may be made without departing the gist of the present invention.

WHAT IS CLAIMED IS:

1. An apparatus for baking a photosensitive resist deposited on a semiconductor wafer, comprising:

a hot plate for generating heat to bake said resist;

a plurality of spacers for supporting said wafer to be spaced over said hot plate with variable distance, said spacers having the upper end part abutting with the edge of said wafer and the lower end part connected with said hot plate; and

spacer movement means for raising or lowering said spacers to adjust the interval between said wafer and hot plate.

2. An apparatus as defined in Claim 1, wherein each of said spacers has a cylindrical form with peripherally spiral grooves connected with corresponding spirally grooved hole formed in said hot plate, and said spacer movement means includes a grip formed on said lower end part of each spacer, said grip being used to raise or lower the corresponding spacer by rotating.

3. An apparatus as defined in Claim 1, wherein said spacers are connected with said hot plate to be displaced in sliding motion, and said spacer movement means includes a plurality of screws inserted into the side of said hot plate to respectively fix said spacers, so that said spacers may be raised or lowered through said sliding motion and fixed by said screws.

4. An apparatus as defined in Claim 1, wherein said spacers are connected with said hot plate to be displaced in sliding motion, and said spacer movement means includes a plurality of externally powered drivers for respectively driving said spacers and a controller for controlling said drivers to automatically control the position of said spacers.

5. An apparatus as defined in one of Claims 1 to 4, wherein each of said spacers further includes a stopper provided at the upper end to support the periphery of said wafer.

6. An apparatus substantially as herein described with reference to the accompanying drawings.

The Patent Office

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Application No: GB 9822000.7 **Examiner:** Miss E.L.Rendle
Claims searched: 1-6 **Date of search:** 17 January 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H1K (KLHX, KMBX)

Int Cl (Ed.6): F27D 3/12; G03F 7/40; H01L 21/00.

Other: EPOQUE: WPI, PAJ, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2 137 414 A	(SILICON VALLEY GROUP) see whole document.	-
A	US 5 431 700	(FSI INTERNATIONAL) see whole document.	-
A	US 5 226 056	(NIHON SHINKU GIJUTSU) see whole document.	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.